The effect of environment on invasibility in the Commelinaceae.

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Invasive species *Callisia fragrans*, photo by Karen Graffius

“Ideal weed characteristics”

1. Rapid growth rates
2. High fecundity
3. High trait plasticity

adapted from Baker (1974) “The Evolution of Weeds”

Australia's Weed Risk Assessment Program

Form A **Weed Risk Assessment question sheet**

Answer yes (y) or no (n), or don't know (leave blank), unless otherwise indicated

Persistence attributes	8.01 Prolific seed production (>5000/m2/yr)
	8.02 Evidence that a persistent propagule bank is formed (>1 yr)
	8.03 Well controlled by herbicides
	8.04 Tolerates or benefits from mutilation, cultivation or fire
	8.05 Effective natural enemies present in Australia

http://www.affa.gov.au/ 2004

Tradescantia fluminensis

in Myer's Park, Tallahassee, Florida, USA.

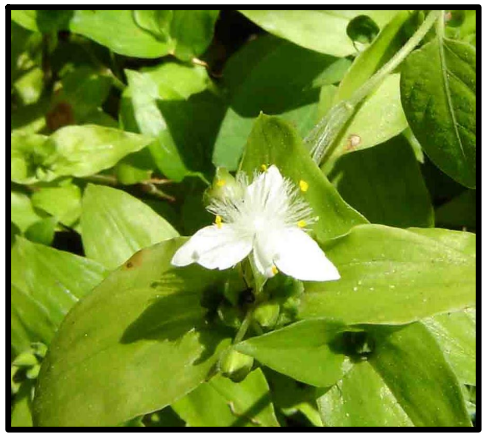
Talk organization.

Series of experiments designed to determine what makes an invasive species invasive:

1. Factorial experiment: role of environmental quality.

2. Competition experiment: common competitor.

3. Resistance experiment: generalist herbivore.

Invasive	Non-invasive
	
Tradescantia fluminensis	*Tradescantia blossfeldiana*
Tradescantia zebrina	*Tradescantia brevifolia*
Murdannia keisak	*Murdannia bracteata*
Murdannia nudiflora	*Murdannia simplex*
Commelina benghalensis	*Commelina bracteosa*

Commelina benghalensis

in four environments

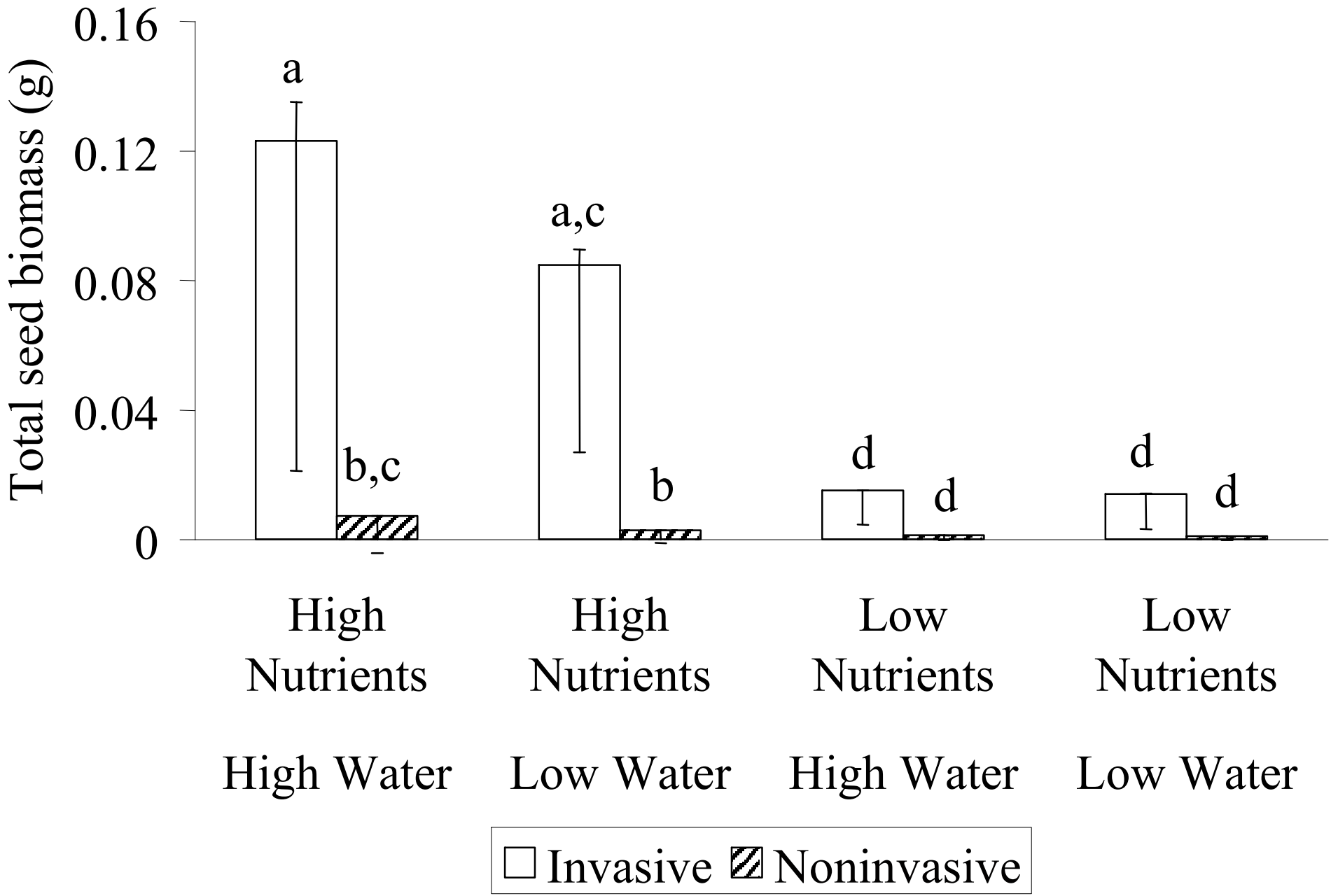
	High Water	Low Water
High Nutrients		
Low Nutrients		

Predictions

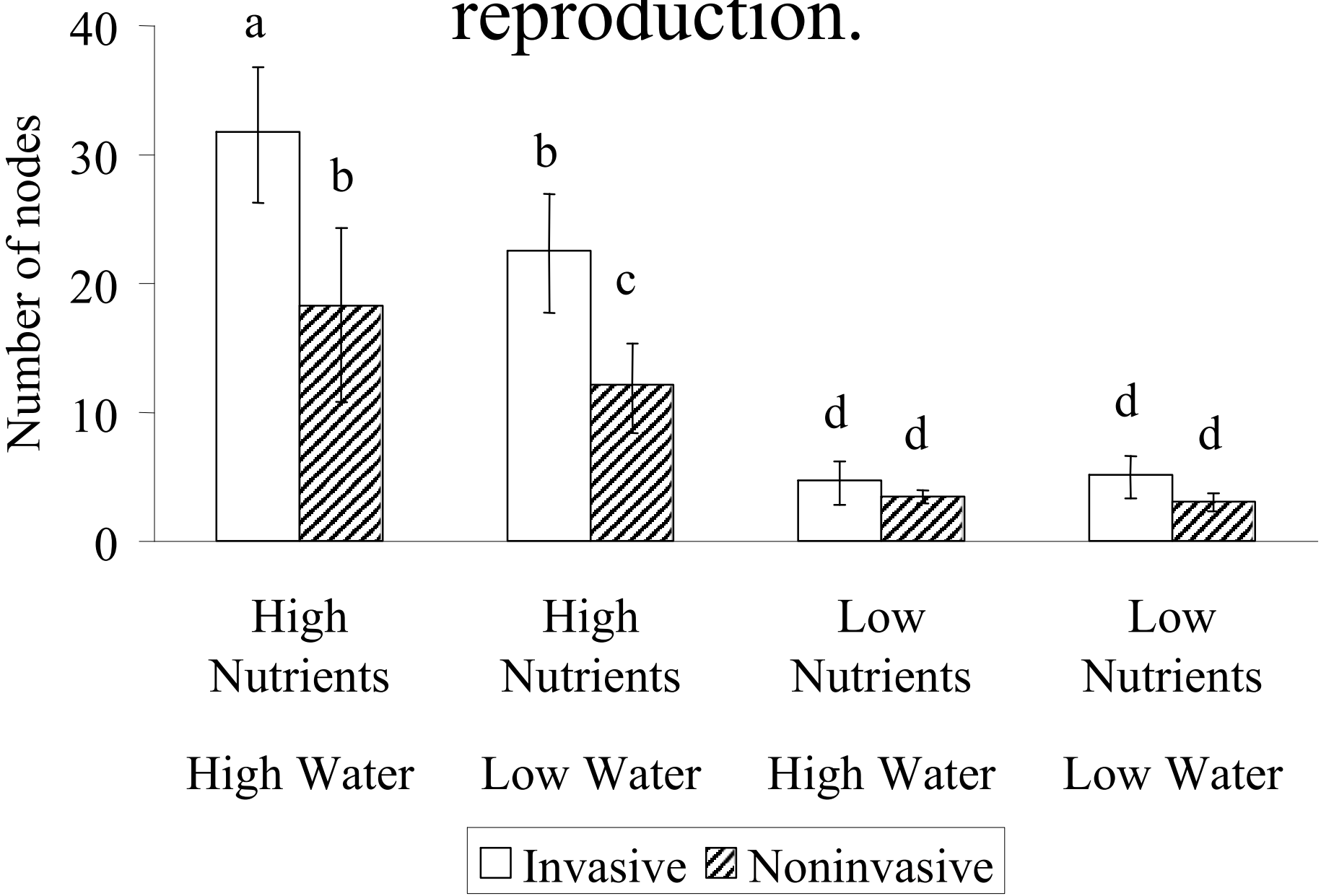
1. Invasive species should outperform noninvasive species.
   a. Fecundity
   b. Vegetative reproduction

2. Invasive species should have traits that permit this enhanced performance.
   a. high relative growth rate (RGR)
   b. high Specific Leaf Area (SLA) (thin leaves)
   c. plastic Root:Shoot

Invasive species are more fecund.



Invasive species have greater vegetative reproduction.



What allows invasive species to have greater fecundity and vegetative reproduction than non-invasive species?

1. high RGR
2. high SLA
3. plasticity in Root:Shoot

Trait associations:

1. RGR: Relative growth rate was higher for invasive species in the low water, high nutrient environment.

2. Specific leaf area: thin leaves were marginally associated with invasiveness in one environment.

3. Root:Shoot: Invasive species had more plastic allocation to root:shoot across two environments.

Can any of these traits be used to predict invasiveness?

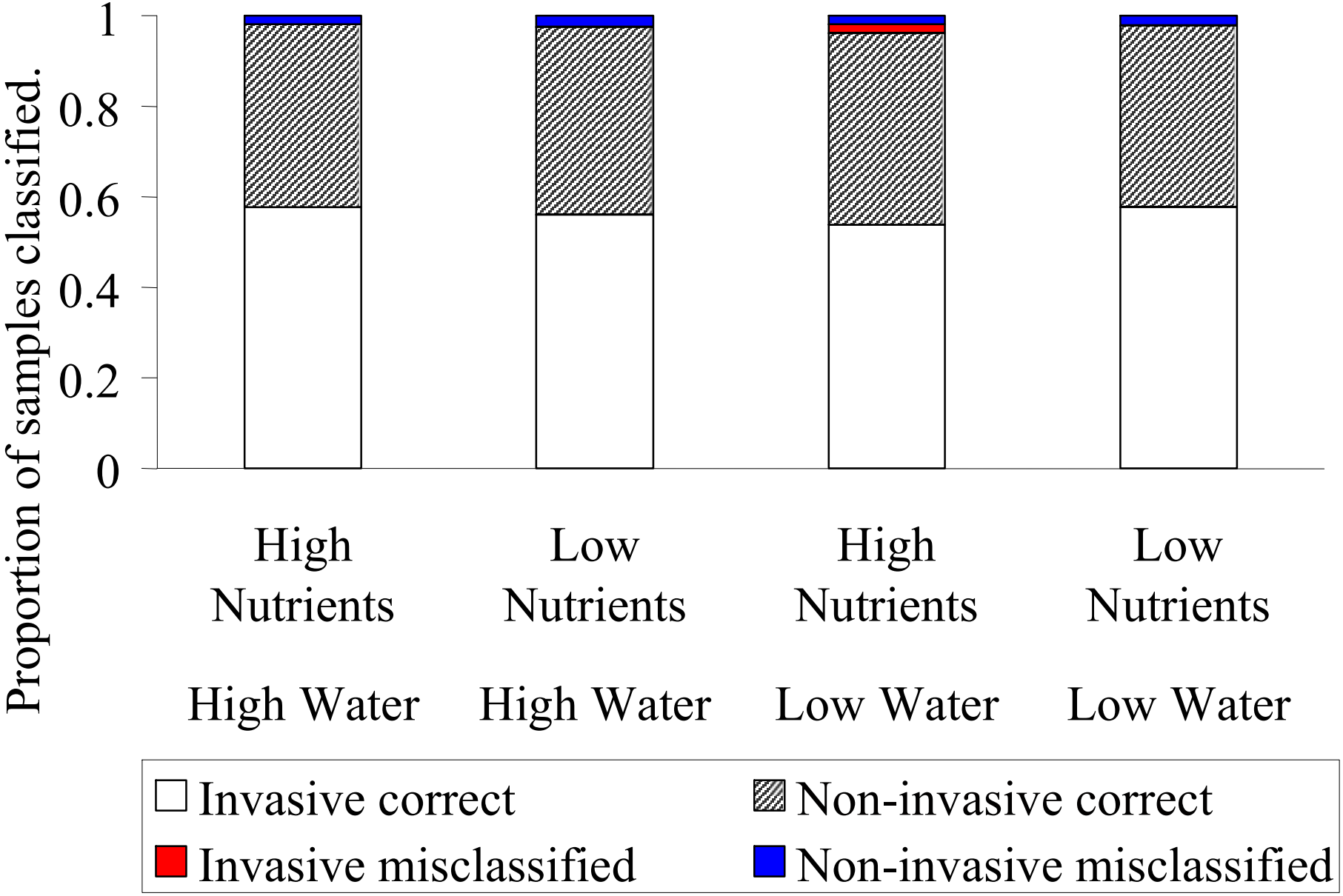
- First approximation of this using discriminant function analysis (DFA).

- Cross-validation.

- Separate analyses by treatment.

- Using predictors: SLA, number of seeds, biomass of seeds, number of nodes, final biomass, RGR, root:shoot.

Discriminant function analysis summary



DFA: Summary of significant univariate statistics

Source	R-square
High Water High Nutrients	
Number of seeds	NA
Biomass seeds	0.15
Number nodes	0.23
Final biomass	0.61
RGR	0.084
Root:Shoot	0.18
SLA	NA

Source	R-square
High Water Low Nutrients	
Number of seeds	NA
Biomass seeds	NA
Number nodes	0.16
Final biomass	0.76
RGR	0.60
Root:Shoot	0.18
SLA	NA

Source	R-square
Low Water High Nutrients	
Number seeds	0.19
Biomass seeds	0.23
Number nodes	0.44
Final biomass	0.48
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SLA	NA

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Experiment 1: Summary

1. Some traits might be associated with invasive dayflowers.

2. **Whether a trait is associated with invasiveness is environment-dependent.**

Experiment 2: Competition experiment.

No competition and competition with grass treatments

Tradescantia zebrina and *T. brevifolia*

Experiment 2: Summary

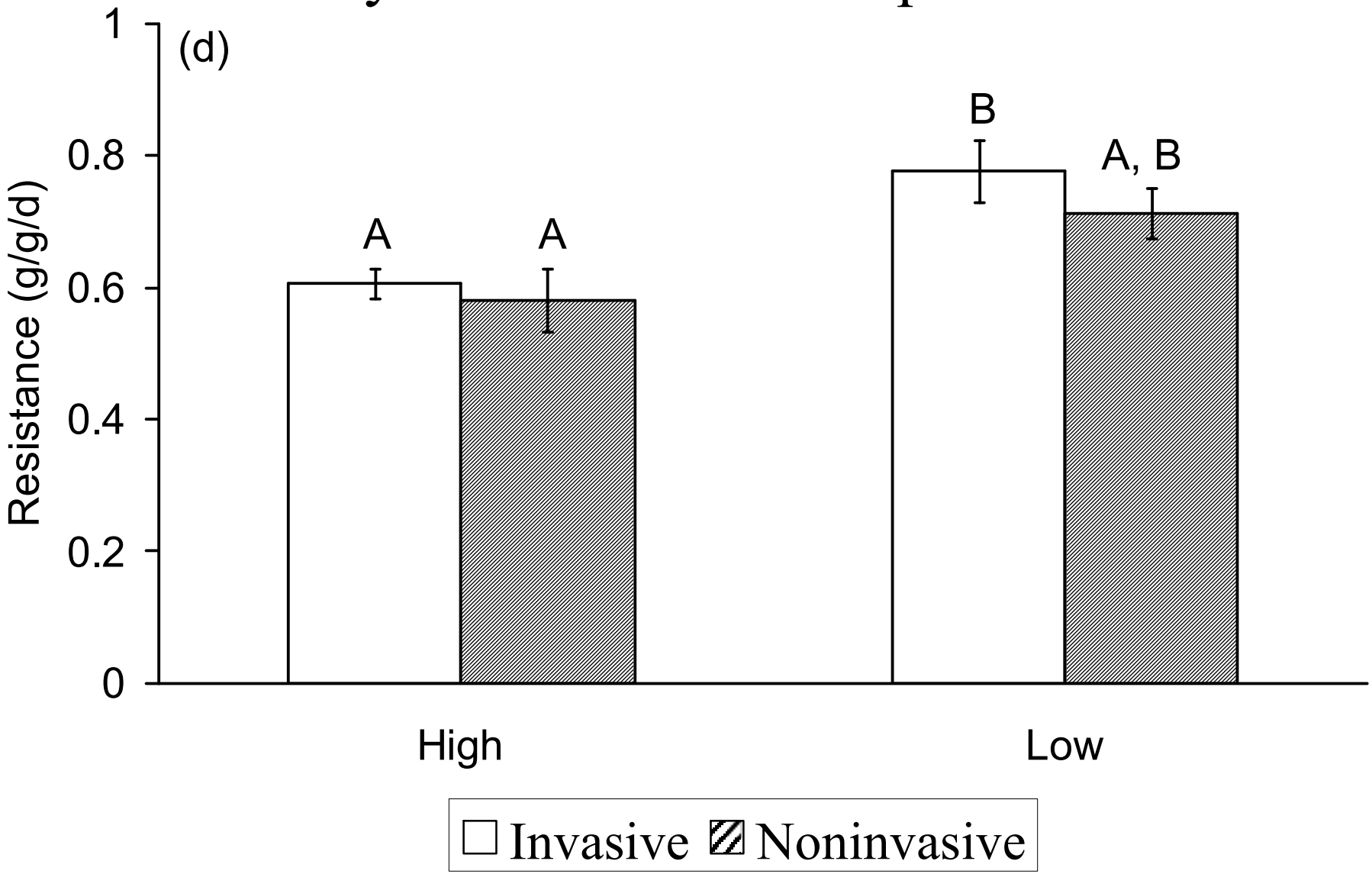
1. Invasive species respond more opportunistically to increases in resource availability.

2. Invasive species have thinner leaves (higher SLA).

Experiment 3: Response to herbivory.

Spodoptera frugiperda on leaf of
Tradescantia zebrina (invasive)

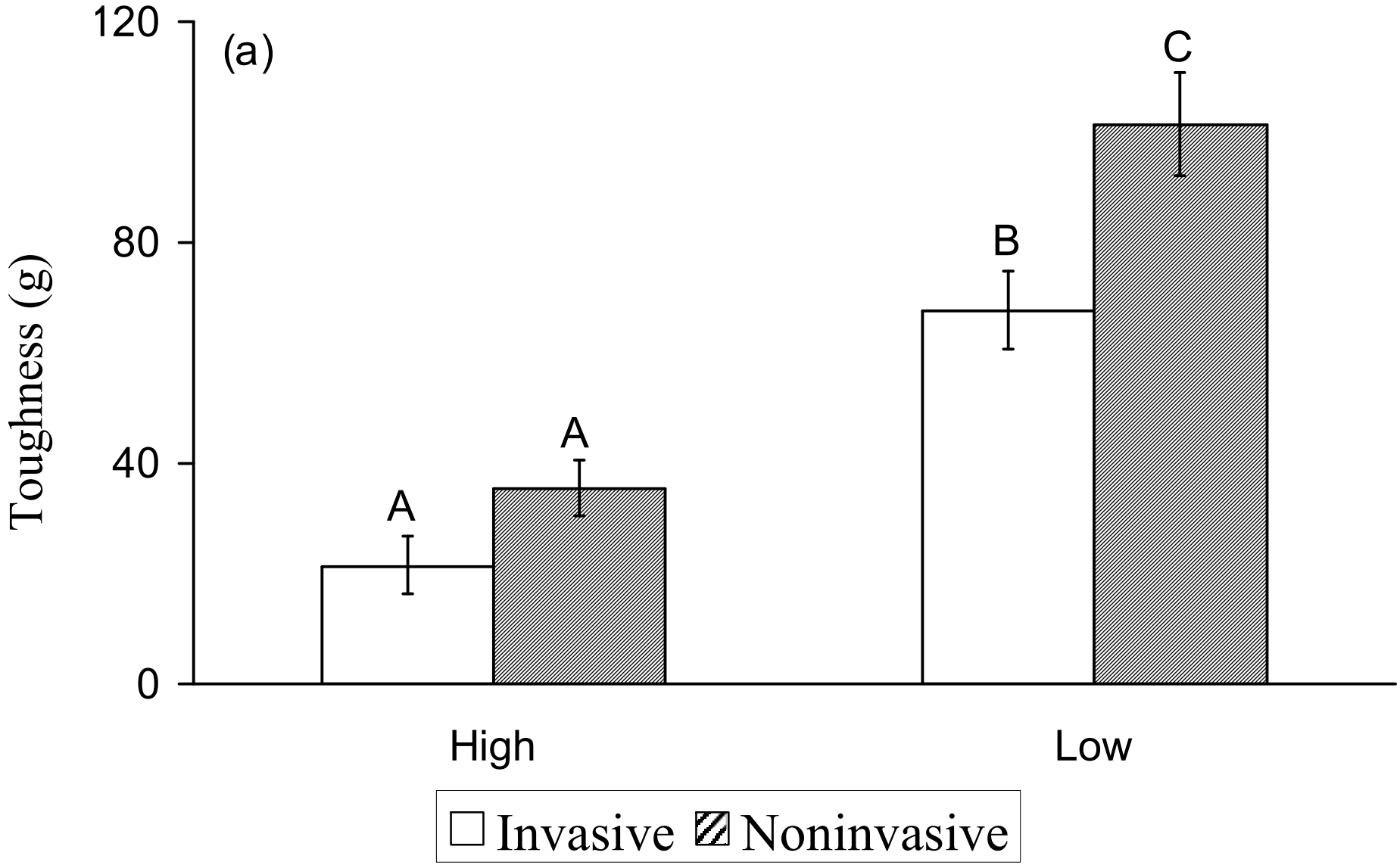
Are invasive species less resistant to herbivory than noninvasive species? No.



Penetrometer: a.k.a. high tech toughness measurer.

Do noninvasive species have tougher leaves?

Yes.



Experiment 3: Summary.

1. Invasive and noninvasive species do not differ in resistance.

2. Noninvasive species have tougher leaves.

Summary of traits associated with invasiveness.

Invasive species have:

1. Opportunistic growth
2. High fecundity (high quality environments)
3. High vegetative reproduction
4. High relative growth rates
5. Plastic root:shoot allocation
6. Less tough leaves

Take-home message

Detecting traits associated with invasiveness depends on environment.

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